
Chapter 3

Learning the Basics

This chapter contains a step-by-step example ALOHA scenario describing a chlorine release at a fictional treatment plant in South Dakota. Follow along, using your own copy of ALOHA (Windows or Macintosh), in order to familiarize yourself with its menus and features. For more information about any aspect of ALOHA, check the Reference chapter.

Guided tour


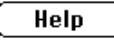
The Central Water Facility treatment plant is located in a rural area about 2 miles from Sioux Falls, South Dakota. The plant uses 1-ton containers of chlorine in the water treatment process (these tanks are 2.5 feet in diameter and 6.8 feet long). The highest-risk operation at the plant is the changing of chlorine tanks. This operation is done only during daytime hours. We'll use ALOHA to assess the potential hazard from one of many possible accident scenarios. In this exercise, we'll assume that while being moved into the building, a single container begins to leak through a valve located in the center of one end (this valve is one-half inch in diameter). The tank contains 1 ton of chlorine when it begins to leak. The date and time of the accident are assumed to be June 25, 2000, at 2:30 p.m. Local meteorologists have provided a description of typical weather conditions at Sioux Falls. These conditions are: a wind speed of 5 miles per hour from the south, measured at a height of 10 meters; partly cloudy skies, air temperature of 72°F, and 50 percent relative humidity. We'll use ALOHA to see:

- the “footprint,” representing the area downwind of the release that may be at risk.
- predicted chlorine concentrations at the Central Valley Elementary School, located about 1,500 yards downwind of the treatment plant.

Note As you use ALOHA, you'll enter information on a series of dialog boxes to describe your scenario. On each dialog box, you'll see at least one **Help** button, which you can use to access online help. Click any of these buttons at any time to view an explanation of the ALOHA feature you're using or input value that you must enter into the model. Once you've finished reading the help information, if you are using Microsoft Windows, when you are ready to go back to using ALOHA, close or minimize the Help window. If you're using a Macintosh, click **Cancel** to exit from the online help.

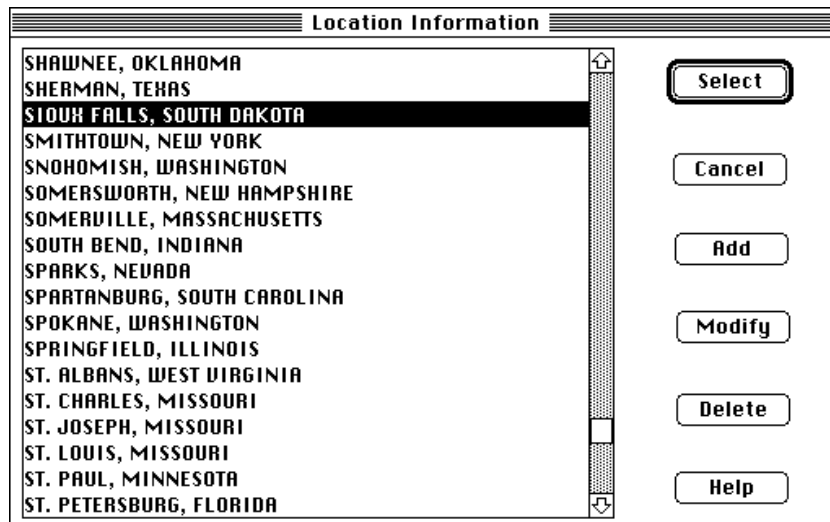
Describing the Time and Place

Your first tasks are to start ALOHA, and then describe the time and place of the scenario.

- 1 Start ALOHA. (In Windows 95, NT, or 98, click the **Start** button, point to **Programs**, then choose the **ALOHA** item from the **Aloha** submenu. On a Macintosh, double-click the ALOHA program icon, , located in the ALOHA Folder on your hard drive. In Windows 3.1, click the program icon, located in the ALOHA program group in Program Manager.)
- 2 Read the list of ALOHA's limitations (click  to see more details), then click **OK**.
- 3 Select **Location** from the **SiteData** menu. You'll see a list of the names of cities included in ALOHA's location library.



- 4 Type the characters “si” to quickly move to SIOUX FALLS, SOUTH DAKOTA. Check to be sure that this name is highlighted, then click **Select**.

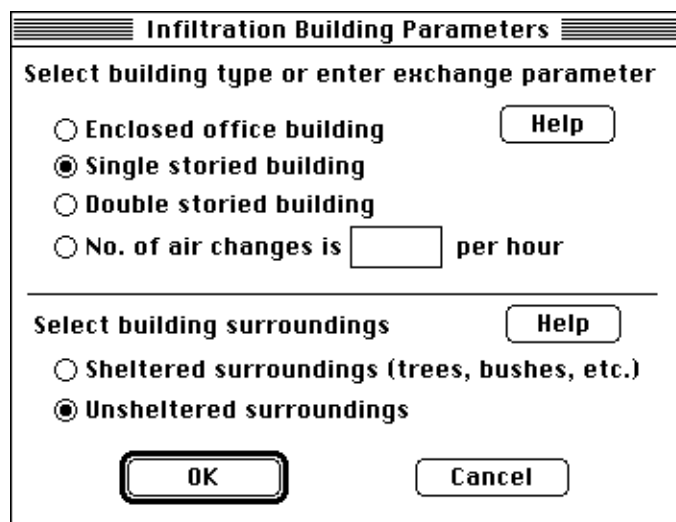


- 5 ALOHA uses information about building type, along with other information such as wind speed and air temperature, to determine indoor infiltration rate and to estimate

indoor concentration and dose at a location of concern. In this example, the location of concern is the Central Valley Elementary School. To estimate infiltration rate into a building, ALOHA assumes that all doors and windows are closed. Choose **Building Type** from the **SiteData** menu.



- 6 The school is a single-storied building, surrounded mostly by open fields. Check to be sure that **Single storied building** is selected, then click **Unsheltered surroundings**. Click **OK**.

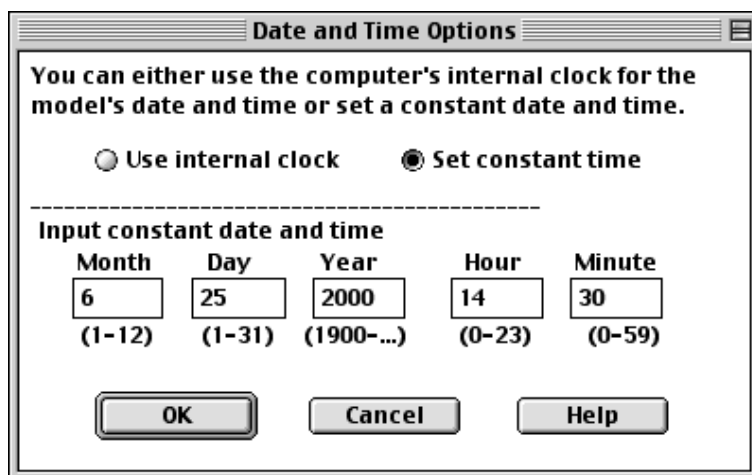


- 7 Select **Date & Time** from the **SiteData** menu to enter the date and time for the scenario.



- 8 Click **Set constant time**. The scenario date is June 25, 2000, so type **6** in the Month box, **25** in the Day box, and **2000** in the Year box. The accident time is 2:30 in the afternoon. ALOHA requires time of day in 24-hour time, so type **14** in the Hour box

and **30** in the Minute box (click **Help** to learn how to convert a time value to 24-hour time). Click **OK**.



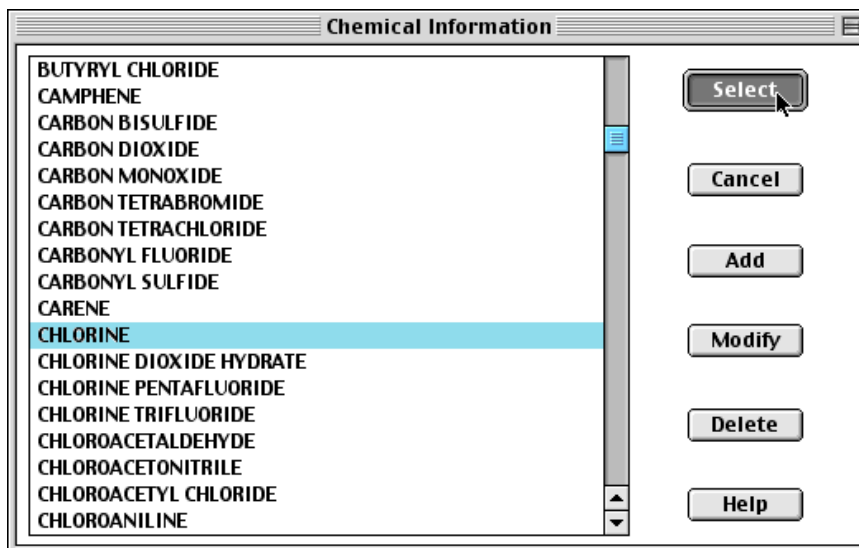
The "Date and Time Options" dialog box contains the following elements:

- Header: "Date and Time Options"
- Instruction: "You can either use the computer's internal clock for the model's date and time or set a constant date and time."
- Radio buttons: "Use internal clock" (unselected) and "Set constant time" (selected).
- Section: "Input constant date and time"
- Input fields: Month (6), Day (25), Year (2000), Hour (14), and Minute (30). Each field has a range below it: (1-12), (1-31), (1900-...), (0-23), and (0-59) respectively.
- Buttons: "OK", "Cancel", and "Help".

Choosing a Chemical

As you build your ALOHA scenario, your next task is to choose the chemical that is being released.

- 1 To choose chlorine from ALOHA's chemical library, select **Chemical** from the **SetUp** menu. Find CHLORINE in the list (quickly type the characters "ch" to locate chlorine more rapidly in the list), click on this name, then click **Select**.



The "Chemical Information" dialog box displays a list of chemicals with "CHLORINE" selected. The list includes:

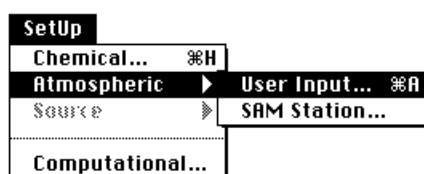
- BUTYRYL CHLORIDE
- CAMPENE
- CARBON BISULFIDE
- CARBON DIOXIDE
- CARBON MONOXIDE
- CARBON TETRABROMIDE
- CARBON TETRACHLORIDE
- CARBONYL FLUORIDE
- CARBONYL SULFIDE
- CARENE
- CHLORINE**
- CHLORINE DIOXIDE HYDRATE
- CHLORINE PENTAFLUORIDE
- CHLORINE TRIFLUORIDE
- CHLOROACETALDEHYDE
- CHLOROACETONITRILE
- CHLOROACETYL CHLORIDE
- CHLOROANILINE

Buttons on the right include: "Select" (with a mouse cursor), "Cancel", "Add", "Modify", "Delete", and "Help".

Describing the Weather

You next must describe the current weather conditions and ground roughness (a measure of the roughness of the terrain over which the gas cloud passes). The weather conditions for this scenario are a wind speed of 5 miles per hour (mph) from the south, measured at a height of 10 meters. About 3 tenths of the sky is covered by clouds, the air temperature is 72°F, and relative humidity is about 50 percent. Ground roughness is “Open Country,” because this is a rural farming area, containing open fields, with few trees and buildings.

- 1 You must choose one of two options from ALOHA’s **Atmospheric** menu, depending on whether you wish to enter weather information manually or from a portable monitoring station (called a “SAM Station”). In this example, you’ll enter information manually. In the **SetUp** menu, point to **Atmospheric**, then click **User Input**.



- 2 On the first Atmospheric Options dialog box, type “5” in the wind speed box, then click **MPH**. Type “S” in the wind direction box (to indicate that the wind is from the south), then click the righthand button under the “Measurement height above ground is:” heading. This button represents a wind measurement height of 10 meters. Check to be sure that **Open Country** ground roughness is selected. Under the “Select Cloud Cover:” heading, click the fourth button from the left; it represents 3 tenths cloud cover. Once the dialog box on your screen looks like the one below, click **OK**.

Atmospheric Options

Wind Speed is: ☐ Knots ☒ MPH ☐ Meters/Sec.

Wind is from : Enter degrees true or text (e.g. ESE)

Measurement Height above ground is:

☐ ☒ OR ☐ enter value: ☐ feet ☒ meters

Ground Roughness is:

☒ Open Country OR ☐ Input roughness (Z₀): ☐ in ☒ cm

Select Cloud Cover:

☐ ☐ ☒ ☐ OR ☐ enter value: (0-10)

☐ complete cover ☐ partly cloudy ☐ clear

- On the second Atmospheric Options dialog box, type “72” in the air temperature box, then click **F** to indicate that temperature is in degrees Fahrenheit. ALOHA uses the wind speed, cloud cover, and date and time information that you’ve entered to automatically select atmospheric stability class “B” (stability is a measure of the amount of turbulence in the atmosphere; the more turbulent the air, the more quickly a pollutant cloud is diluted; “B” is a relatively less stable—that is, more turbulent—stability class). Check to be sure that **No inversion** is selected, then click the button representing **medium** (50 percent) relative humidity. Once the dialog box on your screen looks like the one below, click **OK**.

Atmospheric Options 2

Air Temperature is: Degrees ☒ F ☐ C

Stability Class is: ☐ A ☒ B ☐ C ☐ D ☐ E ☐ F

Inversion Height Options are: ☒ No Inversion ☐ Inversion Present, Height is: ☒ Feet ☐ Meters

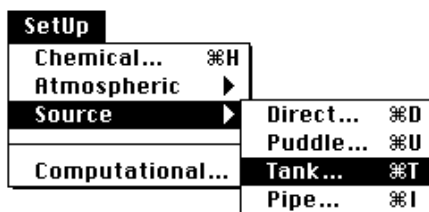
Select Humidity:

☒ wet ☐ medium ☐ dry OR ☐ enter value % (0-100)

Describing the Release

You’re now ready to enter information about the release itself—that is, to “set the source”—for this scenario.

- Since the chlorine at the Central Water Facility treatment plant is stored in tanks, this scenario should be modeled as a **Tank** source: in the **SetUp** menu, point to **Source**, then click **Tank**.



- 2 Next, describe the tank's general shape, orientation, and dimensions. The chlorine is stored in standard 1-ton containers. First, click **Horizontal cylinder**. Type "2.5" in the diameter box, then click **feet**. Type "6.8" in the length box. ALOHA automatically calculates the tank volume. Click **OK**.

Tank Size and Orientation

Select tank type and orientation:

Horizontal cylinder ☒ Vertical cylinder ☐ Sphere ☐

Enter two of three values:

length diameter volume

2.5 6.8 250

☒ feet ☐ meters ☒ gallons ☐ cu feet

OK Cancel Help

- 3 Next, describe how much chlorine is stored in the tank, and indicate its physical state (gas or liquid). Chlorine is a gas at ambient temperatures, but it's usually stored as a pressurized liquid, so click **Tank contains liquid**. Check to be sure that **Chemical stored at ambient temperature** is selected (the tank is not refrigerated in this scenario), then click **OK**.

Chemical State and Temperature

Enter the state of the chemical: ☒ Tank contains liquid ☐ Tank contains gas only ☐ Unknown

Enter the temperature within the tank: ☒ Chemical stored at ambient temperature ☐ Chemical stored at 72 degrees ☒ F ☐ C

OK Cancel

- 4 Next, enter the amount of chlorine present in the tank. In the scenario, the tank contains 1 ton of chlorine. You can enter the amount of chemical into ALOHA in any of several ways. In this case, you know the mass (weight) of chlorine in the tank, so click **tons (2,000 lbs)**, then type “1” in the tank mass box. Click **OK**.

Liquid Mass or Volume

Enter the mass in the tank OR volume of the liquid

The mass in the tank is: ☐ pounds
☒ tons(2,000 lbs)
☐ kilograms

OR

Enter liquid level OR volume

The liquid volume is: ☒ gallons
☐ cubic feet
☐ liters
☐ cubic meters

% full by volume

OK **Cancel** **Help**

- 5 Next, describe how the chlorine is escaping from its container. In the scenario, a half-inch diameter valve located at the center of one end of the tank is leaking. Check to be sure that **Circular opening** is selected. Click **inches**, then type “0.5” in the opening diameter box. Click **Short pipe/valve**, then click **OK**.

Area and Type of Leak

Select the shape that best represents the shape of the opening through which the pollutant is exiting

☒ Circular opening ☐ Rectangular opening

Opening diameter: ☒ inches
☐ feet
☐ centimeters
☐ meters

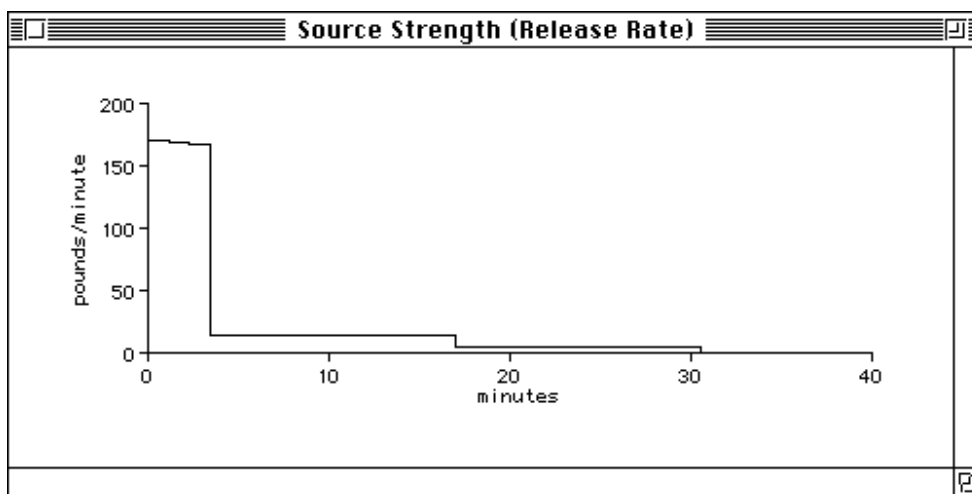
Is leak through a hole or short pipe/valve?
☐ Hole ☒ Short pipe/valve

OK **Cancel** **Help**

- 6 Next, indicate the height of the leak above the tank bottom. Type in **50** for the percent of the way to the top of the tank, since the valve is located at the center of one end of the tank. Click **OK**.

ALOHA then calculates the rate of release of chlorine from the tank, the duration of the release, and the total amount released. You'll see these calculation results in the **Text Summary** window and in the source strength graph.

- 7 Choose **Source Strength** from the **Display** menu to see the source strength graph (below) for this scenario. The graph shows the predicted averaged release rate during the hour after the release begins.



On the graph, time since the release started (from 0 to 40 minutes) is shown on the horizontal axis, and release rate is shown on the vertical axis. You can see from this graph that because the chlorine is escaping from a pressurized container, ALOHA predicts that release rate starts out high, then declines as container pressure drops. The highest step on this graph is the Maximum Averaged Sustained Release Rate.

In the Text Summary (below), under the “Source Strength Information” heading, you can see two release rate estimates: the Maximum Computed Release Rate and the Maximum Average Sustained Release Rate. ALOHA predicts release rate from a puddle, tank, or gas pipeline as a series of up to 150 brief timesteps: the Maximum Computed Release Rate is the highest of these release rates. ALOHA then averages this series of many release rates into between one and five release rates, each averaged over a time period of at least 1 minute: the Maximum Average Sustained Release Rate is the highest of these averaged release rates. To save calculation time, ALOHA uses only the averaged release rate(s) to make its footprint estimates.

Text Summary

SITE DATA INFORMATION:
 Location: SIOUX FALLS, SOUTH DAKOTA
 Building Air Exchanges Per Hour: 0.43 (unsheltered single storied)
 Time: June 25, 2000 @ 1430 hours CDT (user specified)

CHEMICAL INFORMATION:
 Chemical Name: CHLORINE Molecular Weight: 70.91 kg/kmol
 TLV-TWA: 0.5 ppm IDLH: 10 ppm
 Footprint Level of Concern: 10 ppm
 Boiling Point: -29.25° F
 Vapor Pressure at Ambient Temperature: greater than 1 atm
 Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
 Wind: 5 mph from s at 10 meters No Inversion Height
 Stability Class: B Air Temperature: 72° F
 Relative Humidity: 50% Ground Roughness: open country
 Cloud Cover: 3 tenths

SOURCE STRENGTH INFORMATION:
 Leak from short pipe or valve in horizontal cylindrical tank
 Tank Diameter: 2.5 feet Tank Length: 6.8 feet
 Tank Volume: 250 gallons Tank contains liquid
 Internal Temperature: 72° F
 Chemical Mass in Tank: 1 tons Tank is 68% full
 Circular Opening Diameter: .5 inches
 Opening is 1.25 feet from tank bottom
 Release Duration: 31 minutes
 Max Computed Release Rate: 170 pounds/min
 Max Average Sustained Release Rate: 169 pounds/min
 (averaged over a minute or more)
 Total Amount Released: 827 pounds
 Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

- 8 The Text Summary window is like a blackboard: you can check its contents at any time to verify that you’ve entered correct values into ALOHA, or to review ALOHA’s results. If your Text Summary window doesn’t look like the one above, revise any incorrect information by choosing the appropriate menu item, then modifying the information that you entered. For example, if you indicated that the building is sheltered rather than unsheltered, choose **Building Type** from the **SiteData** menu again, click **Unsheltered surroundings**, then click **OK**. When you are sure that the Text Summary information is correct, you’re ready to move on to the next steps.

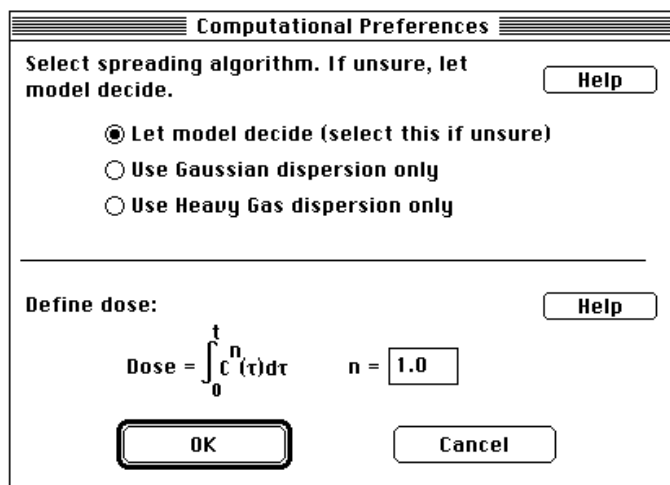
Checking the Computational Setting

Unless you specifically change its default setting, ALOHA uses information about the properties of the chemical and the amount of chemical released to choose whether to make Gaussian or heavy gas dispersion computations. Check to be sure that ALOHA is set to this default.

- 1 Select **Computational** from the **SetUp** menu.



- 2 Check to be sure that **Let model decide (select this if unsure)** is selected. Click **OK**.

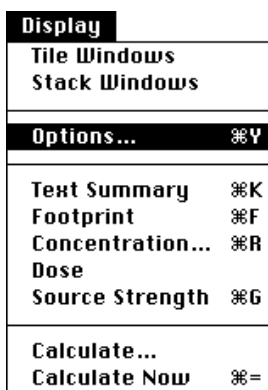


Choosing a Level of Concern and Plotting a Footprint

To obtain a footprint estimate, you first must choose a Level of Concern (LOC). An LOC is a threshold concentration of a pollutant gas, usually the concentration above which a hazard is believed to exist. ALOHA plots a “footprint,” which represents the zone where the ground-level pollutant concentration may exceed your LOC at some time after a release begins.

Note No LOC represents an exact line between hazardous and non-hazardous conditions, because people differ in their sensitivity to chemicals (for example, old, sick, or very young people may be more sensitive to chemicals than healthy adults). An LOC that's appropriate for one person may be too high for somebody else. When you use an LOC in ALOHA, familiarize yourself with its definition, to be sure it's appropriate for the work that you're doing and the population that you're concerned about. Treat ALOHA's footprint as a rough estimate of the true hazard zone for an accidental release.

- 1 Choose **Options...** from the **Display** menu.



- 2 The LOC for this scenario is chlorine's Immediately Dangerous to Life and Health (IDLH) level. IDLH values have been established for many toxic chemicals; the IDLH for chlorine is 10 ppm. A chemical's IDLH is an estimate of the maximum concentration in the air to which a healthy worker could be exposed without suffering permanent or escape-impairing health effects. Many other toxic thresholds besides IDLH exist. Click the topmost **Help** button on the "Display Options" dialog box to learn more about choosing an LOC.

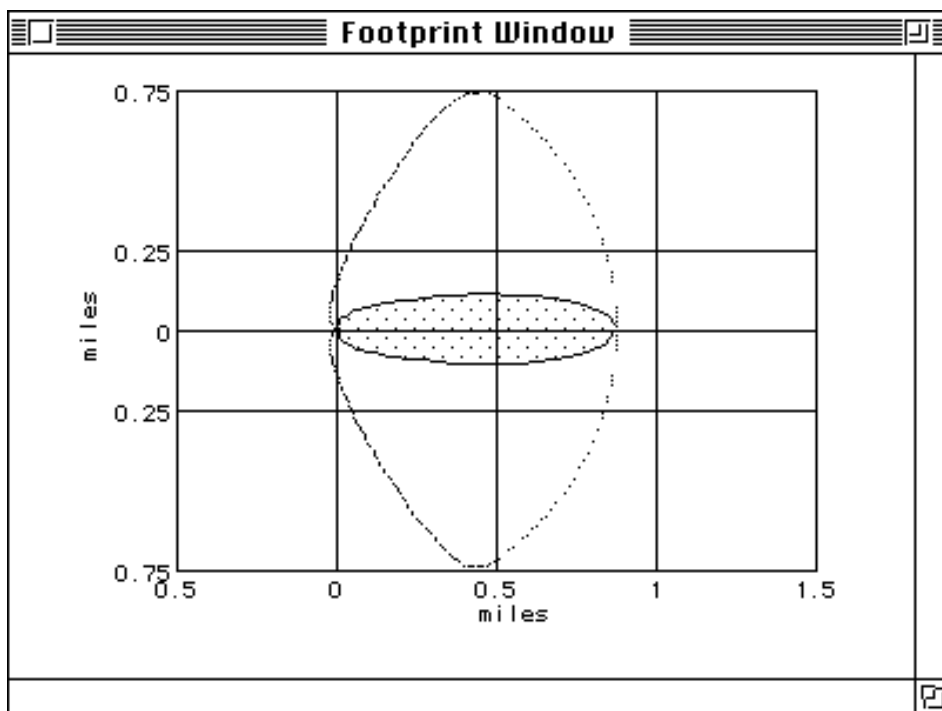
Check to be sure that **IDLH Concentration**, as well as **Plot on grid and auto-scale to fit window**, are selected. Select either **English units** or **Metric units**, depending on your preference; ALOHA's computation results will be displayed in the units that you choose (English units have been selected for this example). Click **OK**.

Display Options	
Select Level of Concern or Output Concentration: <div> <input type="radio"/> Default LOC not set in library <input checked="" type="radio"/> IDLH Concentration <input type="radio"/> Enter value: <input type="text" value="10"/> </div> <div> <input checked="" type="radio"/> ppm <input type="radio"/> milligrams/cubic meter </div>	
Select Footprint Output Option: <div> <input checked="" type="radio"/> Plot on grid and auto-scale to fit window. <input type="radio"/> Use user specified scale. </div>	
Select Output Units: <div> <input checked="" type="radio"/> English units <input type="radio"/> Metric units </div>	
<input type="button" value="OK"/>	<input type="button" value="Cancel"/>

- 3 Choose **Footprint** from the **Display** menu to view ALOHA's footprint.

Display	
Tile Windows	
Stack Windows	
Options...	⌘Y
Text Summary	⌘K
Footprint	⌘F
Concentration...	⌘R
Dose	
Source Strength	⌘G
Calculate...	
Calculate Now	⌘=

You'll see ALOHA's footprint diagram for this scenario. On the diagram, the shaded oval represents the area where chlorine concentrations are predicted to exceed the LOC (in this case, the IDLH) at some time after the release begins. This area is predicted to extend for almost a mile downwind of the leaking cylinder.



Dashed lines along both sides of the footprint indicate uncertainty in the wind direction. The wind rarely blows constantly from any one direction. As it shifts direction, it blows a pollutant cloud in a new direction. The “uncertainty lines” around the footprint enclose the region within which, about 95 percent of the time, the gas cloud is expected to remain.

- 4 Check the Text Summary. You’ll see the line of text, “Model Run: Heavy Gas,” informing you that ALOHA used the heavy gas module to make its footprint estimate. Because a cloud of chlorine is heavier than air, ALOHA models it as a heavy gas rather than as a gas that is about the same weight as air.

Checking Concentrations at a Location of Concern

You can use ALOHA not only to estimate the extent of the area that could be at risk in an incident (that’s the footprint), but also to obtain predicted indoor and outdoor concentrations at any location of special concern during the hour after a release begins. The Central Valley Elementary School is located about 1,500 yards downwind of the treatment plant. You have already indicated the school’s building type and degree of shelter from the wind. Next, you’ll indicate the location of the school relative to the release point at the treatment plant:

- 1 Choose **Concentration** from the **Display** menu.

Display	
Tile Windows	
Stack Windows	
Options...	⌘Y
Text Summary	⌘K
Footprint	⌘F
Concentration...	⌘R
Dose	
Source Strength	⌘G
Calculate...	
Calculate Now	⌘=

- 2 Click **Relative Coordinates**, to indicate that you are describing the school's location in terms of its downwind and crosswind distance relative to the release point (you otherwise could choose to describe the school's location in terms of geographic—north-south, east-west—distances). Type "1500" in the downwind distance box, then click **yards**. Type "0" in the crosswind distance box (when you enter a crosswind distance of "0", you're indicating that the wind is blowing the gas cloud directly towards the location of concern, so that concentrations will be as high as possible; ALOHA's concentration graph then represents the "worst case" prediction for the location). Click **OK**.

Concentration and Dose Location

Specify the location at which you want to evaluate the concentration and dose over time.

☒ **Relative Coordinates**
 (Downwind,Crosswind)

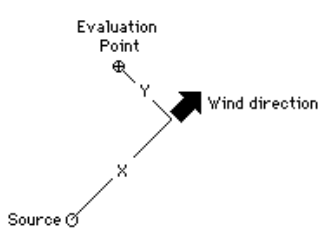
☐ **Fixed Coordinates**
 (East-West,North-South)

Input X, the downwind distance from the source and Y, the perpendicular distance from the downwind axis.

Input X, the downwind distance:

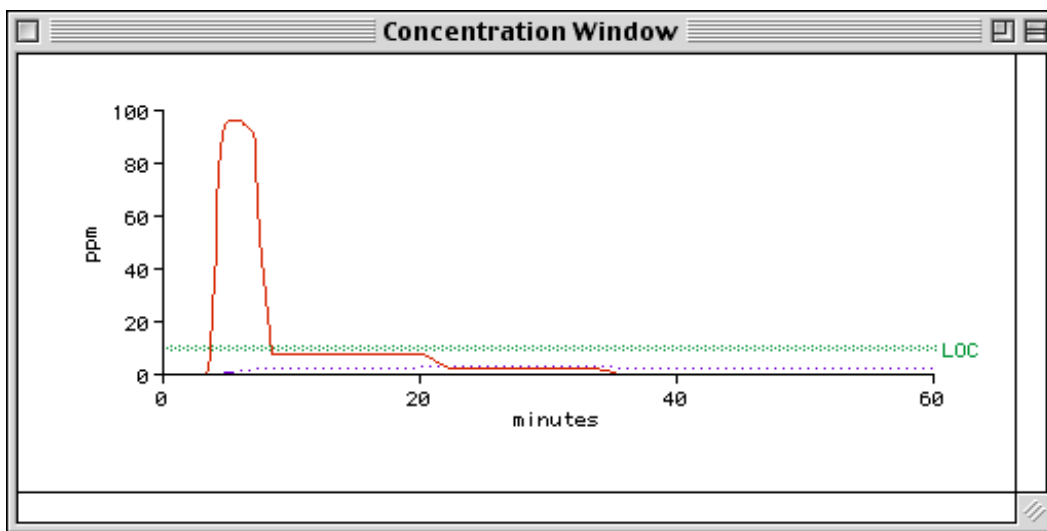
Input Y, the crosswind distance :

☐ feet
☒ **yards**
☐ miles
☐ meters
☐ kilometers



- 3 ALOHA then displays a graph of predicted chlorine concentrations at the school during the hour after the release begins. The horizontal axis of this graph represents

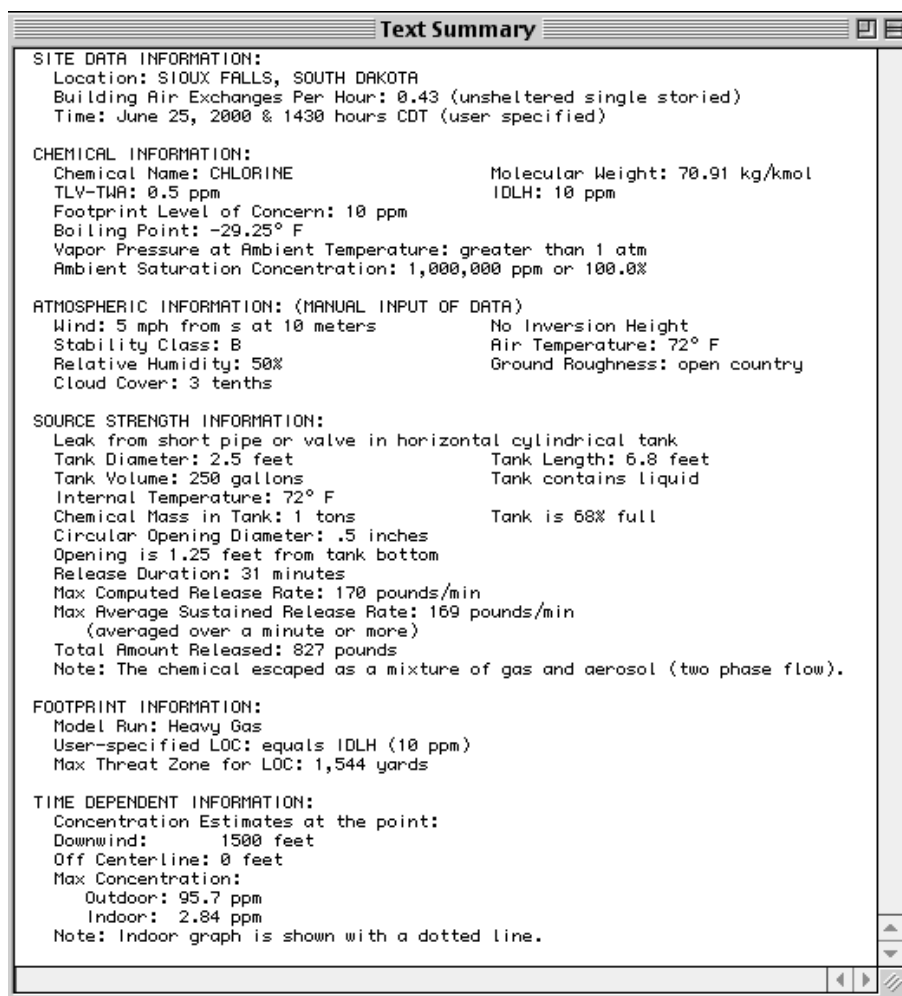
time (from 0 to 60 minutes after the release start), and the vertical axis represents concentration at the location. Three lines are visible on this graph. The solid red line represents the predicted outdoor, ground-level concentration. The dashed blue line represents predicted concentration inside a building of the type you selected using the **Building Type** menu item in the **SiteData** menu. To draw this line, ALOHA assumes that the building's doors and windows are closed and that its ventilation system is off. The wider, horizontal green line represents the LOC.



ALOHA predicts that the cloud of chlorine would arrive at the school in about 4 minutes (that's when the outdoor concentration line begins to rise steeply on the graph), under the conditions of this scenario. You also can see that the indoor concentration is predicted to remain much lower than the outdoor concentration, as long as the school's door and windows are closed. You also can see that ALOHA predicts that outdoor concentration would exceed the LOC for this scenario only briefly, and that indoor concentration would not exceed the LOC. When you use ALOHA in planning or response, however, you may wish to compare predicted concentrations with other toxic thresholds besides IDLH. The IDLH is intended to represent hazard to healthy adults; you may wish to choose a different value to use as your LOC when you're concerned about hazard to children. Be sure that the LOC that you choose reflects the hazard that you are concerned about, and is conservative enough for the uses to which you're putting your ALOHA results.

Here's how the Text Summary window should look, now that you have completed your work with this example scenario (note that depending on the type of computer you use,

some of the numbers that you see on your screen may be slightly different than those in the following figure):



ALOHA also can estimate the dose of chlorine to which people at the elementary school may be exposed. However, don't use ALOHA's dose calculations unless you are trained in toxicology or can ask a toxicologist to assist you.

Exiting (Quitting) ALOHA

- 1 When you've completed your work with ALOHA, just choose **Exit** from the **File** menu if you're using Windows, or **Quit** from the **File** menu if you're using a Macintosh. (You can also first save any ALOHA scenario either in an archive format or as a file you can reopen later in ALOHA; check the section of the Reference chapter describing the **File** menu to learn how to do this).

